

Appl. No. : **10/630,439**
Filed : **July 29, 2003**

AMENDMENTS TO THE DRAWINGS

Please add new Figures 34-37, as enclosed.

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REMARKS

In response to the Office Action, Applicant respectfully requests the Examiner to reconsider the above-captioned application in view of the foregoing amendments and the following comments.

Discussion of Restriction Requirement

In the Restriction Requirement, dated April 6, 2005, the Examiner made a restriction to the following groups:

- I. Claims 1-2, 6-12, drawn to simulation of a system by directly solving field equations modified by the addition of dummy field.
- II. Claims 3-4, drawn to a data structure for use in numerical analysis of a simulation of a system represented by an n-dimensional mesh, further including definitions of a parameter of the dummy field associated with the nodes of the mesh.
- III. Claim 5, drawn to a data structure for use in numerical analysis of a simulation of a system represented by an n-dimensional mesh.
- IV. Claims 13-16, drawn to an apparatus for simulating n-dimensional mesh.

In response, Applicant elected Group I. Applicant notes that it appears that Claim 13 should be in Group I instead of Group IV. Claim 13 recites how the field equations of Claim 12 are modified by the solving component of Claim 12. Applicant respectfully requests correction of groupings.

Discussion of Objections to the Drawings

In the Office Action, the Examiner objected to drawings under 37 C.F.R. § 1.83(a). The Examiner stated that certain claimed features were not shown in the drawings. Applicant respectfully traverses this rejection. Nonetheless, Applicant has provided herewith new Figures 34-39 to further illustrate aspects of the system that are presently described. Applicant respectfully submits that no new matter has been added by the addition of these figures. Applicant respectfully submits that these figures are supported by at least the claims and the specification. For example, Applicant sets forth at least certain locations describing the respective figures: Figure 34 - Claim 1 and paragraph [0027]; Figure 35 and Claim 2 and paragraphs [0032] – [0033]; Figure 36 - Claim 10 and paragraphs [0039] - [0097]; and Figure 37 - Claims 11 and 12 and paragraphs [0097] - [138].

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Discussion of Amendments to the Specification

Applicant notes, that due to a printing error, certain symbols in the application as filed listed a “?” instead of its true symbol. By this Paper, Applicant has amended the specification to correct this. Applicant submits that no new matter has been added by this—the symbols are correctly listed in the present application’s parent, which was incorporated by reference in its entirety.

Discussion of Double Patenting Rejections

In the Office Action, the Examiner rejected Claims 1, 2, and 6-12 under the judicially created doctrine of obviousness-type double patenting. Applicant has enclosed a terminal disclaimer and respectfully submits that the basis of this rejection has been overcome.

Discussion of Claim Rejections Under 35 U.S.C. § 112, First Paragraph

In the Office Action, the Examiner rejected Claims 7, 9, and 12 as failing to comply with the written description requirement. Applicant respectfully submits that these symbols are well known in the domain of electromagnetic fields. Between square brackets reference is made to the description where these well-known definitions are repeated thereby providing additional support in the description. The definitions are as follows:

- μ : magnetic permeability
- A : vector potential, which is related to the magnetic induction B by a differential equation [0088]
- J : electrical current density [0004] [0108]
- ϵ : electrical permittivity
- t : time
- V : scalar potential, which is related to the electrical field E by a differential equation [0088] [0113]
- ρ : electrical charge density [0004]
- E : electrical field intensity [0108]
- B : magnetic flux density [0108]

For further reference, Applicant respectfully requests the Examiner to consider the paper “Teaching Electromagnetic Field Theory Using Differential Forms” by Warnick et al (see e.g. table II). In view of this, Applicant respectfully requests withdrawal of these objections.

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Discussion of Claim Rejections Under 35 U.S.C. § 103(a)

In the Office Action, the Examiner rejected Claims 1, 2, 6, 8, 10, and 11 under 35 U.S.C. § 103(a) as being unpatentable over Warner, K.F., et al., "Teaching electromagnetic theory using differential forms" in view of Ohtsu (U.S. Patent No. 6,499,040).

To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. See M.P.E.P § 2143.03. Applicant respectfully submits that the cited references fail to teach or suggest at least one limitation from each of the above-listed claims.

Applicant respectfully submits that Warnick generally describes electromagnetic field theory using a differential calculus approach and in particular its physical and graphical representation. Warnick merely relates to theoretical mathematical expressions and graphical representations of various electromagnetic quantities. Warnick does not teach nor suggest numerically analyzing a physical system.

In view that Warnick does not relate to numerical solving methods, Warnick is not confronted with problems arising when numerically solving equations describing physical systems, in particular physical systems described using electromagnetic field equations, as described inter alia in paragraph [0019] of the application as filed. One problem in numerically solving problems is that obtained solutions can diverge instead of converging to a single solution. Applicant respectfully submits that this problem is reduced by the claimed invention.

Warnick uses classical electromagnetic quantities electrical field \mathbf{E} , being a one-form, and magnetic field \mathbf{B} , being a two-form, when describing a physical system in terms of electromagnetic field equations. When solving these field equations expressed in terms of \mathbf{E} and \mathbf{B} , or alternatively in terms of electrical flux \mathbf{D} and magnetic field \mathbf{H} , no singularity problem arises and hence a solution can be found using known solving methods. Hence, Warnick does not teach nor suggest a numerical analyzing method dealing with singular differential operations. However when a physical system cannot be described in terms of \mathbf{E} and \mathbf{B} , but needs to be described in terms of electric scalar potential V and magnetic vector potential \mathbf{A} , a singularity problem arises (see paragraph [0094] of the description). This singularity problem arises for example when a physical system comprising semiconductor materials is modeled. The electromagnetic properties of such a system depend on the number of carriers in the

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semiconducting material, which on their turn depend on the values of the electromagnetic quantities (see paragraph [0109] to [0111] and [0168]. Such singularity problem also arises when numerically solving physical systems comprising superconducting materials. Warwick fails to identify this problem and also fails to provide a solution for this problem.

Any physical system described by differential equations in which an underlying symmetry is present, as is the case for electrodynamics, will suffer from this singularity problem when solving these differential equations. One embodiment of the present invention overcomes this singularity problem by introducing a dummy scalar field in the field equations. For example, Claim 1 recites: "directly solving the field equations modified by addition of a dummy field by numerical analysis." Applicant respectfully submits that there is no teaching or suggestion of at least this limitation in the cited references.

Applicant notes that Othsu also does not describe the use of dummy fields to directly solve field equations. In the Office Action, Othsu was cited for the proposition that it was known to submit data to remote locations for processing. Since the cited references in isolation and in combination fail to teach or suggest at least one limitation from each of the above-listed claims, Applicant respectfully submits that the claims are now in condition for allowance.

Summary

Applicant has endeavored to address all of the Examiner's concerns as expressed in the outstanding Office Action. In light of the above amendments and remarks, reconsideration and withdrawal of the outstanding rejections is respectfully requested. If the Examiner has any questions which may be answered by telephone, he is invited to call the undersigned directly.

Respectfully submitted,

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